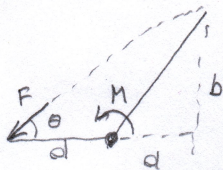


①



$$\vec{M} = \vec{r} \times \vec{F}$$

$$M = r F \sin \theta$$

$$M = F d \sin \theta = F d \frac{b}{\sqrt{(d+d)^2 + b^2}}$$

$$\frac{M}{F} \sqrt{(d+d)^2 + b^2} = d \left(\frac{Fb}{M} \right) \rightarrow K$$

$$\left(\frac{M}{F} \right)^2 [(d+d)^2 + b^2] = d^2 K^2$$

$$[d^2 + 2ad + a^2 + b^2] = d^2 K^2$$

$$d^2 K^2 - d^2 - 2ad - a^2 - b^2 = 0$$

$$d^2 (K^2 - 1) + d(-2a) + (-a^2 - b^2) = 0$$

↓
a'↓
b'↓
c'

$$d = K^2 - 1 \rightarrow 4.0625 \quad 4.29 \quad 4.41 \quad 4.44$$

$$b' = -2d \rightarrow -0.6 \quad -0.8 \quad -1 \quad -1.2$$

$$c' = -a^2 - b^2 \rightarrow -0.9 \quad -1.16 \quad -1.46 \quad -1.8$$

$$d_1 (m) \quad 0.55 \quad 0.622 \quad 0.649 \quad 0.786$$

$$d_2 (m) \quad -0.40 \quad -0.435 \quad -0.473 \quad -0.5168$$

$$T_{cmd1} \quad T_{cmd2} \quad T_{cmd3} \quad T_{cmd4}$$

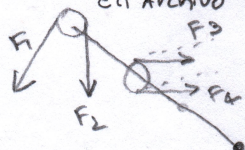
$$M (N \cdot m) \quad 960 \quad 1000 \quad 1040 \quad 1080$$

$$F (N) \quad 2400 \quad 2300 \quad 2200 \quad 2100$$

$$b (m) \quad 0.9 \quad 1 \quad 1.1 \quad 1.2$$

$$d (m) \quad 0.3 \quad 0.4 \quad 0.5 \quad 0.6$$

② La solución para los otros temas se adjunta en archivo xls



$$\phi_p = 175 \text{ mm}$$

$$F_1 = 150 \text{ N} \nearrow 20^\circ$$

$$F_2 = 230 \text{ N} \downarrow$$

$$F_3 = 165 \text{ N} \nearrow 100^\circ$$

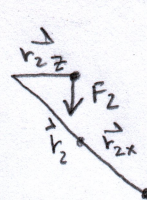
$$F_4 = 320 \text{ N} \nearrow 100^\circ$$

$$\vec{r}_1 = (-405 \hat{i} + 29.93 \hat{j} + 82.22 \hat{k}) \text{ mm}$$

$$\vec{F}_1 = (0 \hat{i} - 140.95 \hat{j} + 51.30 \hat{k}) \text{ N}$$

$$\vec{M}_1 = (13125 \hat{i} + 20777.72 \hat{j} + 57086.33 \hat{k}) \text{ N} \cdot \text{mm}$$

②

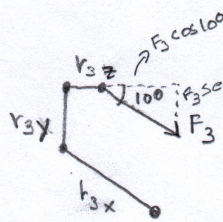


$$\vec{r}_2 = (-405 \hat{i} + 0 \hat{j} - 87.5 \hat{k}) \text{ mm}$$

$$\vec{F}_2 = (0 \hat{i} - 215 \hat{j} + 0 \hat{k}) \text{ N}$$

$$\vec{M}_2 = (-18812.5 \hat{i} + 0 \hat{j} + 87075 \hat{k}) \text{ N} \cdot \text{mm}$$

③

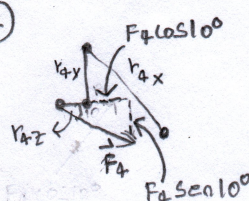


$$\vec{r}_3 = (-180 \hat{i} + 86.17 \hat{j} - 15.19 \hat{k}) \text{ mm}$$

$$\vec{F}_3 = (0 \hat{i} + 28.65 \hat{j} - 162.49 \hat{k}) \text{ N}$$

$$\vec{M}_3 = (1437.5 \hat{i} + 29246.79 \hat{j} + 5157.35 \hat{k}) \text{ N} \cdot \text{mm}$$

④



$$\vec{r}_4 = (-180 \hat{i} - 86.17 \hat{j} + 15.19 \hat{k}) \text{ mm}$$

$$\vec{F}_4 = (0 \hat{i} - 45.14 \hat{j} - 256.05 \hat{k}) \text{ N}$$

$$\vec{M}_4 = (22750 \hat{i} - 46089 \hat{j} + 8126.73 \hat{k}) \text{ N} \cdot \text{mm}$$

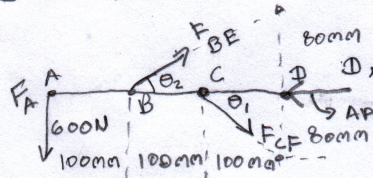
$$\vec{F}_R = (0 \hat{i} - 429.75 \hat{j} - 367.24 \hat{k}) \text{ N}$$

$$\vec{M}_R = (2625 \hat{i} - 54560.07 \hat{j} + 15744.54 \hat{k}) \text{ N} \cdot \text{mm}$$

$$\vec{F}_R = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \vec{F}_4 \quad \vec{M}_R = \vec{M}_1 + \vec{M}_2 + \vec{M}_3 + \vec{M}_4$$

3 - Tcmd +

$$\theta_1 = \tan^{-1} \frac{80 \text{ mm}}{100 \text{ mm}} = 38.66^\circ$$



$$\theta_2 = \tan^{-1} \frac{80 \text{ mm}}{200 \text{ mm}} = 21.8^\circ$$

$$\sum M_C = 600 \text{ N} \cdot 200 \text{ mm} - F_{BE} \sin \theta_2 \cdot 100 \text{ mm} = 0$$

$$F_{BE} = \frac{600 \text{ N} \cdot 200 \text{ mm}}{\sin 21.8^\circ \cdot 100 \text{ mm}} = 3231.298 \text{ N}$$

$$\sum M_B = 600 \text{ N} \cdot 100 \text{ mm} - F_{CF} \sin \theta_1 \cdot 100 \text{ mm} = 0$$

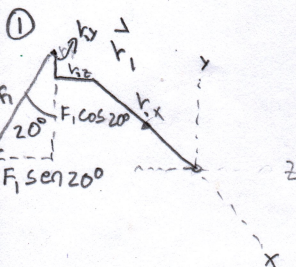
$$F_{CF} = \frac{600 \text{ N} \cdot 100 \text{ mm}}{\sin 38.66^\circ \cdot 100 \text{ mm}} = 960.465 \text{ N}$$

$$\sum F_x = F_{CF} \cos \theta_1 + F_{BE} \cos \theta_2 - D_x = 0$$

$$D_x = 960.465 \text{ N} \cos 38.66^\circ + 3231.298 \text{ N} \cos 21.8^\circ$$

$$D_x = 3748.531 \text{ N}$$

①



$$\vec{r}_1 = (-405 \hat{i} + 29.93 \hat{j} + 82.22 \hat{k}) \text{ mm}$$

$$\vec{F}_1 = (0 \hat{i} - 140.95 \hat{j} + 51.30 \hat{k}) \text{ N}$$

$$\vec{M}_1 = (13125 \hat{i} + 20777.72 \hat{j} + 57086.33 \hat{k}) \text{ N} \cdot \text{mm}$$